

WHAT IS CLAIMED IS:

1. A transmitter device adopting space time transmit diversity multicarrier CDMA scheme, comprising:

an encoding interleaving means for encoding transmit data by performing error correction and for interleaving the encoded data;

a mapping means for mapping output signals from said encoding interleaving means to signal points on a conjugate plane;

a serial to parallel conversion means for converting output signals from said mapping means into  $N_c/SF$  parallel signals, where  $N_c$  is an integer representing the number of points of inverse fast Fourier transform and  $SF$  is an integer and a submultiple of  $N_c$ ;

$N_c/SF$  space time transmit diversity encoding means for encoding in time direction and in space direction the parallel signals from said serial to parallel conversion means;

a plurality of multicarrier CDMA transmit means for respectively copying in parallel output signals from said  $N_c/SF$  space time transmit diversity encoding means to  $SF$  signals, for respectively spreading copied signals, for respectively performing inverse fast Fourier transform of  $N_c$  points with respect to spread signals, and for respectively converting transformed parallel signals into serial signals; and

a plurality of transmit antennas for respectively transmitting output signals from said plurality of multicarrier CDMA transmit means.

2. The transmitter device as claimed in claim 1, wherein said plurality of multicarrier CDMA transmit means comprise means for adding guard intervals to the serial signals, respectively.

3. The transmitter device as claimed in claim 1, wherein each of said plurality of multicarrier CDMA transmit means comprises  $N_c/SF$  copier means for respectively copying in parallel output signals from said  $N_c/SF$  space time transmit diversity encoding means to SF signals, spreading means for spreading  $N_c$  output signals from said  $N_c/SF$  copier means by multiplying spreading codes, an inverse fast Fourier transform means for performing inverse fast Fourier transform of  $N_c$  points with respect to output signals from said spreading means, a parallel to serial conversion means for converting parallel signals from said inverse fast Fourier transform means into a serial signal, and means for adding a guard interval to the serial signal from said parallel to serial conversion means.

4. The transmitter device as claimed in claim 3, wherein

said spreading codes are Walsh Hadamard codes.

5. A receiver device adopting space time transmit diversity multicarrier CDMA scheme, comprising:

a plurality of receive antennas;

a plurality of multicarrier CDMA receive means for respectively converting received signals from said plurality of receive antennas into parallel signals, for respectively performing fast Fourier transform of the converted parallel signals, for respectively inversely spreading transformed signals, and for respectively equalizing and combining inversely spread signals;

space time transmit diversity decoding means for decoding in time direction and in space direction output signals from said plurality of multicarrier CDMA receive means;

a parallel to serial conversion means for converting output signals from space time transmit diversity decoding means into serial signals;

a de-mapping means for de-mapping output serial signals from said parallel to serial conversion means; and

a decoding de-interleaving means for de-interleaving output signals from said de-mapping means and for decoding de-interleaved data by performing error correction.

6. The receiver device as claimed in claim 5, wherein said plurality of multicarrier CDMA receiver means comprise means for removing guard intervals from the received signals, respectively.

7. The receiver device as claimed in claim 5, wherein each of said plurality of multicarrier CDMA receiver means further comprises means for estimating channel for respective subcarriers, and means for respectively equalizing and combining the inversely spread signals in accordance with estimated channels.

8. The receiver device as claimed in claim 5, wherein each of said plurality of multicarrier CDMA receiver means comprises a guard interval removal means for removing a guard interval from the received signal, a serial to parallel conversion means for converting a serial signal from said guard interval removal means into parallel signals, a fast Fourier transform means for performing fast Fourier transform of the parallel signals from said serial to parallel conversion means, inverse spreading means for inversely spreading transformed signals from said fast Fourier transform means by multiplying spreading codes that are the same as spreading codes used in a transmitter device, a channel estimator means for estimating channel for respective

subcarriers, and means for respectively equalizing and combining the inversely spread signals from said inverse spreading means in accordance with estimated channels.

9. The receiver device as claimed in claim 8, wherein each of said plurality of multicarrier CDMA receiver means further comprises an estimated value combiner means for combining channel estimated values from said channel estimator means, and wherein said space time transmit diversity decoding means decode output signals from said plurality of multicarrier CDMA receive means by using combined channel estimated values from said estimated value combiner means.

10. The receiver device as claimed in claim 8, wherein said spreading codes are Walsh Hadamard codes.

11. A wireless communication system including a transmitter device and a receiver device adopting space time transmit diversity multicarrier CDMA scheme,

said transmitter device comprising:

an encoding interleaving means for encoding transmit data by performing error correction and for interleaving the encoded data;

a mapping means for mapping output signals from said encoding interleaving means to signal points on a conjugate

plane;

a serial to parallel conversion means for converting output signals from said mapping means into  $N_c/SF$  parallel signals, where  $N_c$  is an integer representing the number of points of inverse fast Fourier transform and  $SF$  is an integer and a submultiple of  $N_c$ ;

$N_c/SF$  space time transmit diversity encoding means for encoding in time direction and in space direction the parallel signals from said serial to parallel conversion means;

a plurality of multicarrier CDMA transmit means for respectively copying in parallel output signals from said  $N_c/SF$  space time transmit diversity encoding means to  $SF$  signals, for respectively spreading copied signals, for respectively performing inverse fast Fourier transform of  $N_c$  points with respect to spread signals, and for respectively converting transformed parallel signals into serial signals; and

a plurality of transmit antennas for respectively transmitting output signals from said plurality of multicarrier CDMA transmit means,

said receiver device comprising:

a plurality of receive antennas;

a plurality of multicarrier CDMA receive means for respectively converting received signals from said plurality of receive antennas into parallel signals, for respectively

performing fast Fourier transform of the converted parallel signals, for respectively inversely spreading transformed signals, and for respectively equalizing and combining inversely spread signals;

space time transmit diversity decoding means for decoding in time direction and in space direction output signals from said plurality of multicarrier CDMA receive means;

a parallel to serial conversion means for converting output signals from space time transmit diversity decoding means into serial signals;

a de-mapping means for de-mapping output serial signals from said parallel to serial conversion means; and

a decoding de-interleaving means for de-interleaving output signals from said de-mapping means and for decoding de-interleaved data by performing error correction.

12. The wireless communication system as claimed in claim 11, wherein said plurality of multicarrier CDMA transmit means comprise means for adding guard intervals to the serial signals, respectively.

13. The wireless communication system as claimed in claim 11, wherein each of said plurality of multicarrier CDMA transmit means comprises Nc/SF copier means for respectively

copying in parallel output signals from said Nc/SF space time transmit diversity encoding means to SF signals, spreading means for spreading Nc output signals from said Nc/SF copier means by multiplying spreading codes, an inverse fast Fourier transform means for performing inverse fast Fourier transform of Nc points with respect to output signals from said spreading means, a parallel to serial conversion means for converting parallel signals from said inverse fast Fourier transform means into a serial signal, and means for adding a guard interval to the serial signal from said parallel to serial conversion means.

14. The wireless communication system as claimed in claim 13, wherein said spreading codes are Walsh Hadamard codes.

15. The wireless communication system as claimed in claim 11, wherein said plurality of multicarrier CDMA receiver means comprise means for removing guard intervals from the received signals, respectively.

16. The wireless communication system as claimed in claim 11, wherein each of said plurality of multicarrier CDMA receiver means further comprises means for estimating channel for respective subcarriers, and means for respectively equalizing and combining the inversely spread signals in



accordance with estimated channels.

17. The wireless communication system as claimed in claim 11, wherein each of said plurality of multicarrier CDMA receiver means comprises a guard interval removal means for removing a guard interval from the received signal, a serial to parallel conversion means for converting a serial signal from said guard interval removal means into parallel signals, a fast Fourier transform means for performing fast Fourier transform of the parallel signals from said serial to parallel conversion means, inverse spreading means for inversely spreading transformed signals from said fast Fourier transform means by multiplying spreading codes that are the same as spreading codes used in said transmitter device, a channel estimator means for estimating channel for respective subcarriers, and means for respectively equalizing and combining the inversely spread signals from said inverse spreading means in accordance with estimated channels.

18. The wireless communication system as claimed in claim 17, wherein each of said plurality of multicarrier CDMA receiver means further comprises an estimated value combiner means for combining channel estimated values from said channel estimator means, and wherein said space time transmit diversity decoding means decode output signals from said

plurality of multicarrier CDMA receive means by using combined channel estimated values from said estimated value combiner means.

19. The wireless communication system as claimed in claim 17, wherein said spreading codes are Walsh Hadamard codes.